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PAPERS ON SLEET AND GLAZE ("ICE STORMS").

The freezing of rain onto wires, trees, and streets is so disastrous to telephone, telegraph, and power lines and radio-station aeri-als, to trees, and to transportation facilities that such means as can be employed to combat the formation of ice should be made ready before an "ice storm" begins. This involves forecasting the conditions which will cause the glaze to form, i. e., conditions such that liquid drops of water will fall from a relatively warm wind into cold air near the ground. The occurrence of sleet as well as the formation of glaze usually marks such a condition of the atmosphere and thus is a valuable (and noisy) index to glaze formation.

While the form of the precipitation reaching the earth's surface allows a fairly accurate surmise to be made as to critical temperatures aloft, actual observations by means of kites or airplanes, taken in conjunction with observations made at the surface, offer the best basis for "ice-storm" forecasts.

The first article indicates the general conditions under which sleet (and glaze) is formed, and the second discusses the actual meteorological features accompanying the storm of January 20 to 25, 1920, long to be remembered for the great destruction and inconvenience caused by the thick ice which formed over hundreds of thousands of square miles in the eastern United States.—EDITOR.

THE NATURE OF SLEET AND HOW IT IS FORMED.

By CHARLES F. BROOKS, Meteorologist.

[Weather Bureau, Washington, D. C., Apr. 5, 1920.]

SYNOPSIS.

Whereas in current practice in the United States, *sleet* is that form of precipitation which is not snow, rain, or hail, an attempt to make a detailed descriptive and genetic definition seems advisable, and 30 cases of sleet are analyzed as a basis:

Sleet, a rattling type of ice precipitation formed in the free air, has the following characteristics: *Size*, smallest dimensions of largest pieces less than 6 mm. ($\frac{1}{4}$ inch); *form*, angular, irregular, or nearly spherical; *structure*, nongranular ice, part or all of which is cloudy or bubbly (except in extremely small drops), not more than one clear layer.

A sleet particle may be (1) a snowflake partly melted and refrozen, (2) a frozen raindrop, or (3) a frozen combination of snowflake, and raindrop or liquid (not undercooled) cloud droplets.

A generalized vertical section of sleet weather shows sleet as occurring usually with a cloud from which snow is falling through a stratum of air having a temperature above freezing and into air with a temperature below freezing.

INTRODUCTION.

Snow, sleet, rain, and hail are the names applied in the United States to all kinds of precipitation falling to earth out of the free air. Rain and snow need no definition here, and hail, with its large size, usual concentric layer structure, and association with strong thunderstorms, is definitely pictured in the minds of most observers. Thus, sleet, more or less by elimination, covers the great variety of ice particles which seem to give us frozen pictures of every step in the melting transition from snowflake to raindrop. In what category should "graupel" those granular white pellets, like compact miniature snowballs be placed—snow, sleet, or hail? Various names have been applied abroad, e. g., *snow pellets*, *soft hail*, *winter hail*, *grésil*, *Graupeln* (1).

SLEET DEFINITIONS.

It is no wonder then that there has been some difficulty in defining *sleet*. This will be obvious from a glance at Dr. Cleveland Abbe, jr.'s article, "American Definition of 'Sleet.'" (2) So far as the application of the word *sleet* to

a form of precipitation generated in the atmosphere is concerned, there are the following outstanding features evident in this discussion: That "*nothing is sleet that does not rattle on a tin roof or against a window pane*," (C. Alphonso Smith), and that *all sleet is either frozen rain drops or a mixture of rain and snow*. But how can a mixture of rain and snow rattle? Only by being a refrozen or partly refrozen mixture of the two. In the British Isles *sleet* is defined as, "Precipitation of rain or snow together or of partially melted snow." (7) The Weather Bureau's sleet committee, in consequence of not being able to make compatible the definitions mentioning a mixture of rain and snow on the one hand, and frozen raindrops on the other hand, omitted the former conception entirely and the then current (since about 1897) Weather Bureau instructions were continued:

Care should be taken in determining the character of precipitation when in the form of sleet or hail. Only the precipitation that occurs in the form of frozen or partly frozen rain should be called *sleet*. Hail is formed by accretions consisting of concentric layers of ice, or of alternate layers of ice and snow. It frequently happens that snow falls in the form of small round pellets, which are opaque, having the same appearance as snow when packed. This should never be recorded as sleet.—Weather Bureau "Instructions for preparing meteorological forms," Washington, 1913, paragraph 119.

The Weather Bureau thus defined *sleet* as a frozen, hard, practically spherical form of precipitation, and differentiated between *sleet* and *snow* on the basis of whether or not the form of precipitation looks like a frozen or partly frozen raindrop. The distinction is a hard one to draw in practice, for there is no break in the gradation between snow and rain, or therefore, in the gradation of the frozen counterparts of this transition. There was no place in the Weather Bureau definition for irregular pieces of ice. These considerations led to the omission of all but the first sentence in the paragraph 119 quoted, as published in the revised instructions, which went into effect January 1, 1920. Uniformity in practice in re-